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H.2 Biological Studies

Book 1

Pre-Event Bioenvironmental Safety Survey and Evaluation Project Rulison

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PRE-EVENT

BIOENVIRONMENTAL SAFETY SURVEY AND EVALUATION

PROJECT RULISON

by

R. Glen Fuller

July 28, 1969

Prepared for the U. S. Atomic Energy Commission
under Contract No. AT(26-1)-171

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This publication is available from the

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TABLE OF CONTENTS

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SUMMARY AND RECOMMENDATIONS

An ecological survey of the area around the Project Rulison site was made to ascertain the seasonal distribution of range livestock and wild game in the area. This information is required to plan courses of action in the unlikely event of accidental release of radionuclides. The survey was also aimed at identifying any potential adverse consequences of the project for which preventive or remedial action may be needed.

Range Livestock

The National Forest lands lying east and southeast of Rulison SGZ furnish summer grazing for approximately 8,950 "cattle units" (1 unit = 1 cow and calf or 1.3-1.5 yearlings). Cattle are moved onto National Forest allotments starting about mid-June. Peak population is reached by about July 1, and continues through September, when withdrawal to lower elevations begins. The allotments are clear of cattle by October 15, after which the cattle are grazed on Bureau of Land Management allotments or private lands and, finally, fed on dry hay.

It is not anticipated that execution of Project Rulison will have any significant effect on the range cattle or their forage. If on-site monitoring indicates that any release of radionuclides has occurred, it is recommended that an assessment be made of potential radionuclide burdens in exposed livestock to ascertain that edible meat products from the animals are acceptable for human consumption. The extent of such evaluations would depend on the timing of release, the amount and kinds of nuclides involved, and their distribution in the environment.

Dairy cattle were not considered in this survey, since the U. S. Public Health Service, Southwestern Radiological Health Laboratory, provides census data on dairy cows.

Wild Game

The most important big-game animal harvested in the vicinity of the Project Rulison site is the western mule deer. The Battlement area within Game Management Unit 42, in which Rulison SGZ is located, has an estimated mule-deer population of 6,500. The summer range of this population, which is occupied from May through November, is on the top or upper slopes of Battlement Mesa and the high country to the east and southeast of the site. As in the case of range cattle, it is not anticipated that execution of Project Rulison will affect the deer

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The area considered in this survey (see Figure 1) is roughly triangular in shape. It includes the land between the Colorado River and Plateau Creek, extending east northeast approximately 50 miles from the confluence of these streams. This area ranges in elevation from about 4,800 feet at the confluence to 10,800 feet at a few peaks that rise above Battlement Mesa. The elevation of the Mesa is generally between 10,000 and 10,400 feet.

The elevated central part of the area comprises parts of two National Forests: White River National Forest north of the divide between the Colorado River and Plateau Creek, and Grand Mesa National Forest south of this divide. Below the National Forest (NF) lands, about 50 percent of the land is privately owned, the balance being public land administered by the Bureau of Land Management (BLM).

ECOLOGICAL SURVEY

Range-Cattle Distribution

The NF lands in the specified area provide summer range for approximately 8,950 "cattle units", a "unit" being defined as one cow and calf, or 1.5 yearling animals (White River National Forest), or 1.3 yearlings (Grand Mesa National Forest). Of this total, about 4,830 allotted units are in the White River National Forest (Rifle Ranger District, southern half), and about 4,120 are in the Grand Mesa National Forest (Collbran Ranger District). In terms of distance from the Rulison site, allotments comprising about 2,300 NF grazing units lie within 15 miles of SGZ, mainly to the east and southeast of the site; allotments comprising the remaining 6,650 grazing units of the area lie in the same general direction, between 15 and 30 miles from SGZ. This distribution is shown in Figure 2.

The grazing season on the NF lands varies slightly among allotments but may begin as early as June 16 and extend until October 15. For a period varying from 2 to 6 weeks (generally about 6 weeks) before they are moved onto Forest lands, a large percentage of the cattle are grazed on BLM and private lands that border the Forest at lower elevations. The same BLM lands are used to some extent for fall grazing as the cattle are moved out of Forest allotments.

Thus, taking into account the combined use of BLM and NF grazing permits, the area around Rulison SGZ (especially to the east and southeast) is occupied by a considerable population of beef cattle (cows with calves, or yearlings) on native forage from about May 1 through October 31. During the balance of the year the livestock are on private lands at lower elevations, fed mainly on hay harvested along the Colorado River and Plateau Creek and their tributaries. The total wintering population of range livestock in the area around Rulison SGZ probably exceeds the population accounted for as grazing on BLM and NF allotments. For example, no sheep are grazed on the NF allotments, but three BLM allotments provide winter, or fall and spring, grazing for some 7,000 sheep. The summer range for these sheep has not been ascertained, but is apparently outside the area of interest, probably north of the Colorado River, or northwest of Rulison SGZ. Similarly a number of the beef cattle wintered along Plateau Creek and the Colorado River are moved to summer range outside the area of immediate interest. Some of these are taken north of the Colorado (northwest of Rulison SGZ) and others are summered south of Plateau Creek and Rulison SGZ.

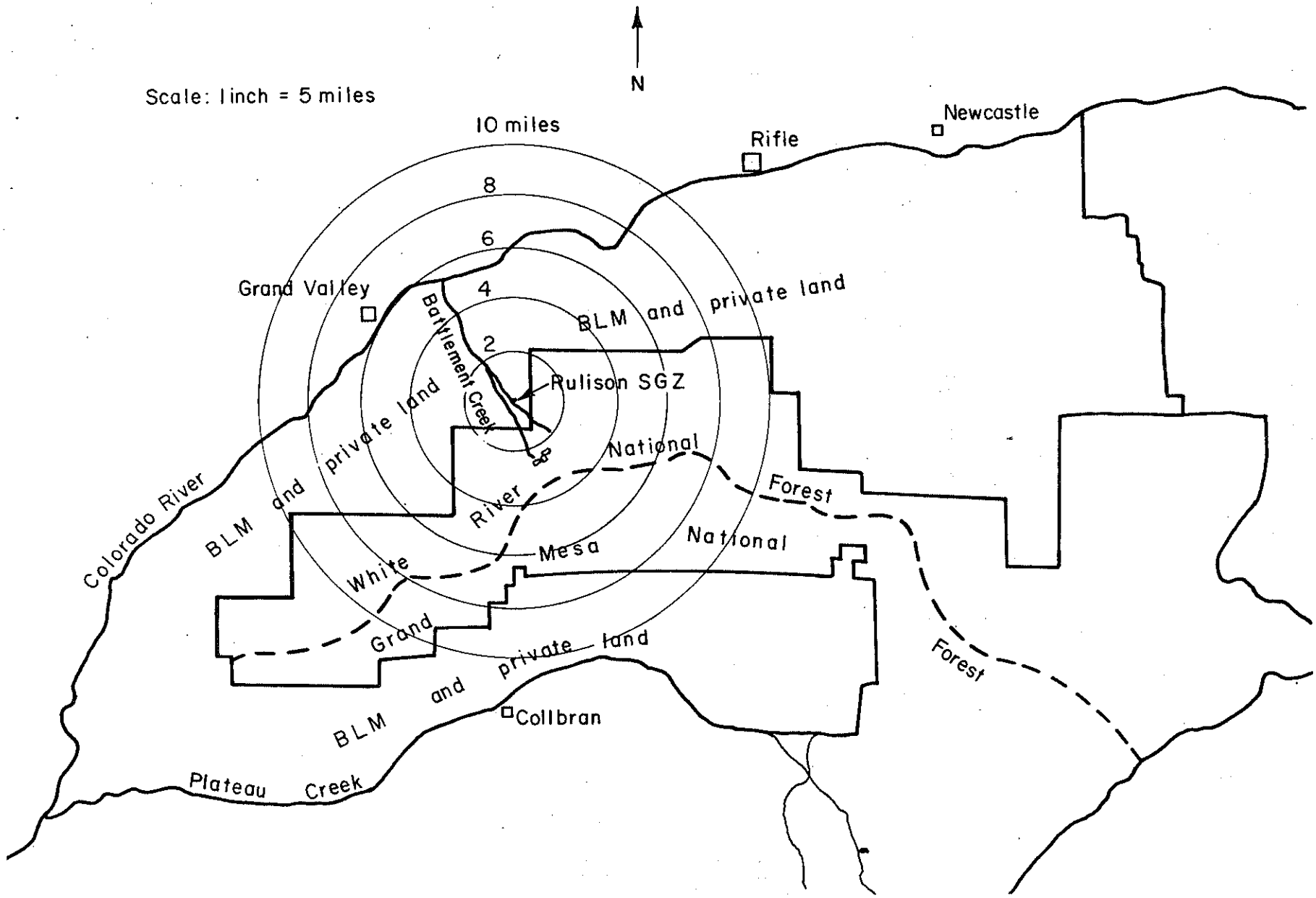
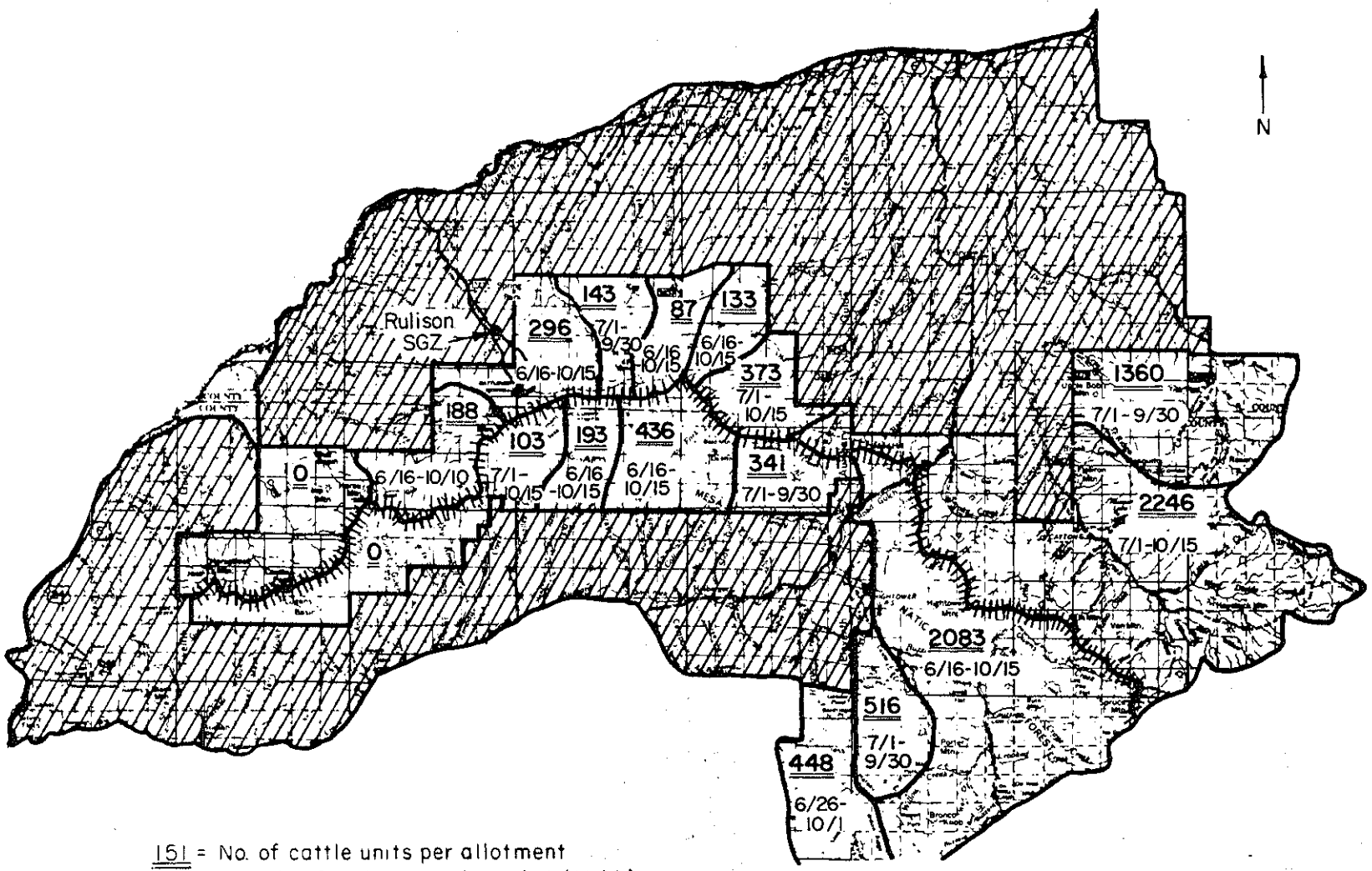


FIGURE 1. BIOENVIRONMENTAL STUDY AREA, PROJECT RULISON



151 = No. of cattle units per allotment
6/16 – 10/10 = Grazing permit period (1968)
///// = Mixed private and BLM lands
HHH = Boundary between White River National Forest (north of boundary) and Grand Mesa National Forest (south of boundary)

Scale: 1 inch = 5 Miles

FIGURE 2. GRAZING ALLOTMENTS ON NATIONAL FOREST LANDS NEAR PROJECT RULISON SGZ

During the period when cattle are grazed on NF allotments, they are tended by a small number of ranch hands or ranchers. It is estimated that the number of riders in the 15 allotments shown in Figure 2 will generally not exceed about 15. However, the number may be somewhat higher for short periods when cattle are being shifted to a different part of an allotment, or during the fall roundup preparatory to moving the animals out of the high country. According to Forest Service personnel, cattle are held in the permit areas for the full term of the allotment period, so roundups take place only a few days before the termination dates shown in Figure 2. The same sources indicate that there should be no serious problem in clearing the area of riders just before event time, should the event be scheduled during the NF grazing season.

Conclusions

In the event of accidental radionuclide release, cattle in the downwind sector from Rulison SGZ could conceivably accumulate radionuclides by inhalation or by ingestion of contaminated forage and drinking water. If on-site monitoring should indicate that a release of radioactivity has occurred, potential radionuclide burdens in exposed livestock should be assessed to ascertain that meat products from the animals are acceptable for human consumption. The extent of such precautionary evaluations would naturally depend on the timing of the release and the amount, kinds, and distribution of radionuclides entering the environment occupied by range cattle.

Wild-Game Distribution and Harvest

The Project Rulison site is located within Colorado Game Management Unit 42, the northerly portion of which is shown in Figure 3. As this figure shows, this portion of Unit 42 is subdivided into three areas: Battlement, Divide Creek, and Grand Mesa. The Battlement area, in which Rulison SGZ is located, and the Divide Creek area, immediately to the east of Battlement, are the areas of primary interest with respect to potential effects of the project on the wild-game population and on the utilization of that population by man.

The most important big-game animal hunted in the area is the western mule deer, and Unit 42 is rated as the second most productive deer harvest area in the state. The first and third most productive units are, respectively, Unit 31 (Roan Creek drainage) and Unit 32 (Parachute Creek Drainage) which adjoin Unit 42 to the north and west across the Colorado River. Within Unit 42, the Battlement area ranks a close second in deer harvest to the Divide Creek area, which comprises the drainages of East and West Divide Creeks.

The following approximate statistics on the deer population and hunting pressure in Unit 42 were provided by Mr. Harold Burdick, Game Biologist, Northwest Regional Office, Colorado Game, Fish and Parks Department.

Area	Estimated Mule Deer Population	Estimated Peak Hunter Population	Estimated Annual Deer Harvest
Battlement	6,500	1,650	1,700
Divide Creek Complex	12,000	2,850	2,500

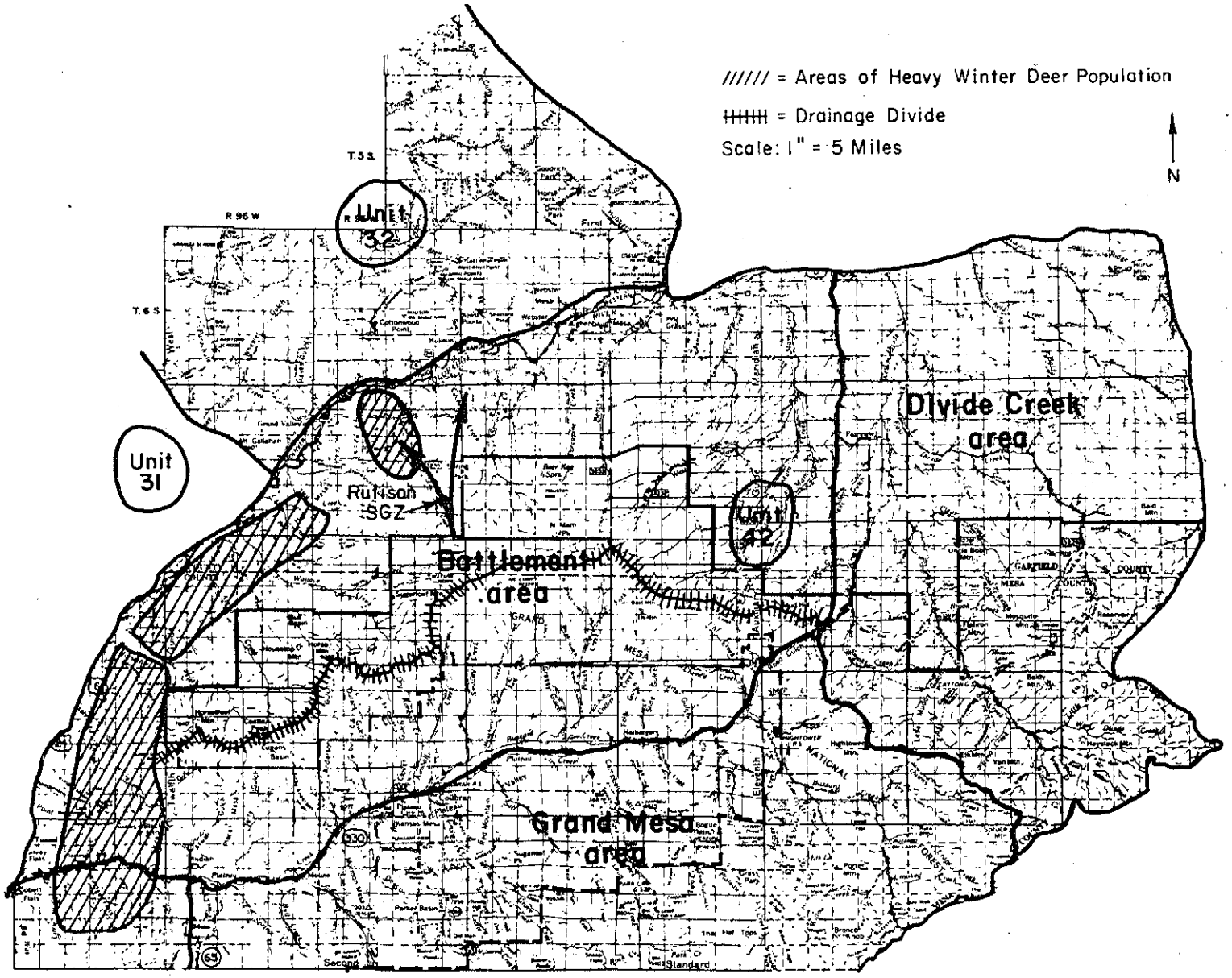


FIGURE 3. NORTHERLY PORTION OF COLORADO GAME MANAGEMENT UNIT 42

The Rulison site is located within 3 to 20 miles of three areas of high population density for overwintering mule deer. These areas are shown in Figure 3; one is located on Morrisania Mesa, northwest of Rulison SGZ. Deer migrating between summer range on Battlement Mesa and winter range on Morrisania Mesa and adjoining Holmes Mesa pass close to Rulison SGZ, as shown by the arrows on Figure 3. Time of migration is weather dependent, but the most probable periods for deer moving past the site are mid-April through mid-May (winter to summer range) and late October through November (summer to winter range).

In 1969, the regular deer season in Unit 42 will extend from October 18 through November 6, with no "post-season" hunt. The bow-and-arrow season will extend from August 16 through September 14. The high country on either side of the divide on Battlement Mesa is a popular one with both bow-and-arrow and rifle hunters. Two professional guides take bow-hunting parties into the area. Guided parties and independent hunters are reported to comprise a hunter population of about 100 during the bow-and-arrow season. Statistics for the regular season are tabulated above. These statistics clearly show the importance of the area of interest in terms of deer-hunting activity.

Elk and bighorn sheep are also found in the area, although their importance is secondary to that of mule deer. Upland game birds (blue grouse, sage grouse, and wild turkey) are also hunted, but are not believed to be of sufficient importance to be discussed in detail here. In 1969 there will probably be a 2-week open season on blue grouse starting September 13, and a 9-day open season on wild turkey starting October 4. Reportedly, hunting is mostly by local people. Peak bird-hunter population during these periods usually occurs on weekends, and is not likely to exceed ten hunters.

Conclusions

No hazard to the deer population from execution of Project Rulison is recognized. If release of radionuclides occurs, an assessment should be made to ascertain that meat products from deer in the affected area are acceptable for human consumption.

The importance of the Battlement and Divide Creek areas for deer hunting should be considered in scheduling Project Rulison operations, and interference with hunting activities should be avoided or minimized..

Battlement Creek Watershed

Potential Water-Pollution Problems

Battlement Creek watershed is a source of drinking water, stock water, and irrigation water for the inhabitants of Morrisania Mesa, located below the Project Rulison site on the East Fork of Battlement Creek. Following the first site visit in February, 1969, the NVOO Effects Evaluation Division was advised that oil, water, and drilling mud in the Hole R-E mud sumps constituted a potential source of pollution of Battlement Creek. (An earlier incident of pollution resulting from sump failure, investigated by the Colorado Game, Fish and Parks Department, is discussed below.) The importance of avoiding further pollution of the stream was pointed out. Additional information collected since the first site visit confirms the initial conclusion that effective preventive action should be taken before event time, to avoid the risk of again polluting this important watershed.

Water rights totaling 68.3 cubic feet per second are assigned to the ditch system supplied by Battlement Creek. The extent of this ditch system is shown schematically in Figure 4; Table 1 shows the water-rights assignments. Mr. Colin Clem, Water Commissioner for District 45 (Battlement Creek), estimates that approximately 1,900 acres of cropland are irrigated from the creek. The irrigated land is predominantly in hay and pasture crops, but also includes fruit orchards and kitchen gardens. Battlement Creek ditches provide drinking water for some 80 to 90 individuals in approximately 20 households. Ditch water is used to fill cisterns, which then serve as the domestic water source. The ditch system also is used for livestock watering.

In connection with the pollution incident mentioned above, Mr. Clem stated that some domestic cisterns had to be drained, washed, and replastered before they could be reused after being filled with oil-contaminated water from Battlement Creek which resulted from the Hole R-EX mud-sump failure in December, 1967. A reexamination of the Rulison site on April 2-3, 1969, showed that the potential sources of pollution still existed at and around Hole R-E. Melting of much of the snow cover had exposed the lower mud sumps which had been snow covered at the time of the February visit. A layer of black oil, estimated to be about 1 inch thick, was on the lower circular sump and behind a smaller dike below that. The amount of oil on the upper sump appeared to be about the same as observed earlier. Figure 5 shows a sketch of the sumps, dikes, and banks as observed April 2-3, in relation to the Battlement Creek drainage. This figure also shows the locations at which water samples were taken on April 3.

Attention also is called to the condition of the west bank of the Hole R-E platform, and to the west dike of the upper mid pit, as observed on April 3, 1969. The bank and dike appeared to be immediately adjacent to the channel of the East Fork of Battlement Creek and about 100 feet from the Hole R-E wellhead. The west bank of the drilling platform sloped steeply down toward the creek channel and appeared to be a poorly consolidated mixture of soil and debris from the drilling and site preparation; the mixture may possibly contain some oily waste, judging by the soil color. The condition of the dike of the upper sump could not be ascertained since most of it was still under snow cover. Adequate steps should be taken to prevent the entry of waste-contaminated bank or dike soil into the adjacent stream channel.

As shown in Figure 5, three water samples were collected in the vicinity of Rulison SGZ during a site visit on April 3, 1969. Sample 1 is from the Main Fork of Battlement Creek, which is isolated from the drill site by a ridge separating it from the East Fork. This sample was selected for reference purposes since heavy snow cover on the East Fork above the drill site made it unfeasible to obtain a reference sample from that point. Samples 2 and 3 are from the East Fork and a tributary downstream from Rulison SGZ, respectively. The results of a standard water-quality analysis performed on the three samples are given in Table 2.

The water quality of two of the three samples is within limits recommended by the USPHS Drinking Water Standards. Sample 2 exceeds the recommended limit for total iron. Perhaps more important is the fact that Samples 2 and 3 from below the drill site were considerably higher than Sample 1 in total dissolved solids, alkalinity, bicarbonate, total hardness, calcium, and magnesium.* The absolute values were not excessively high in any of the samples, and are in themselves no cause for concern. However, the differences between Sample 1 and Samples 2 and 3 suggest that there may be some

* A second set of water samples was collected from the same three locations on May 20, 1969. Levels of total hardness and of most dissolved solids were generally lower, but differences between Sample 1 and Samples 2 and 3 were similar to those shown in Table 2.

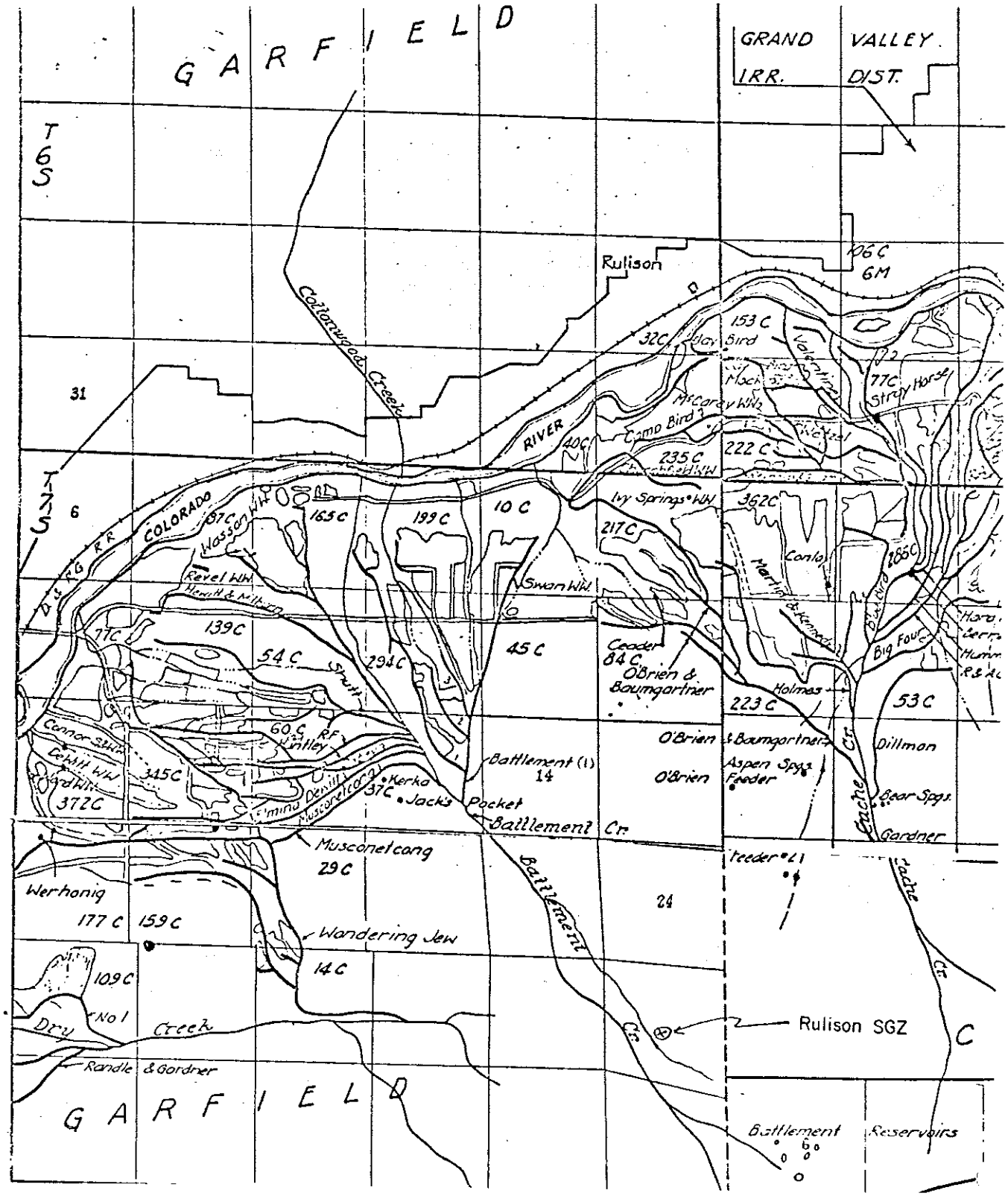
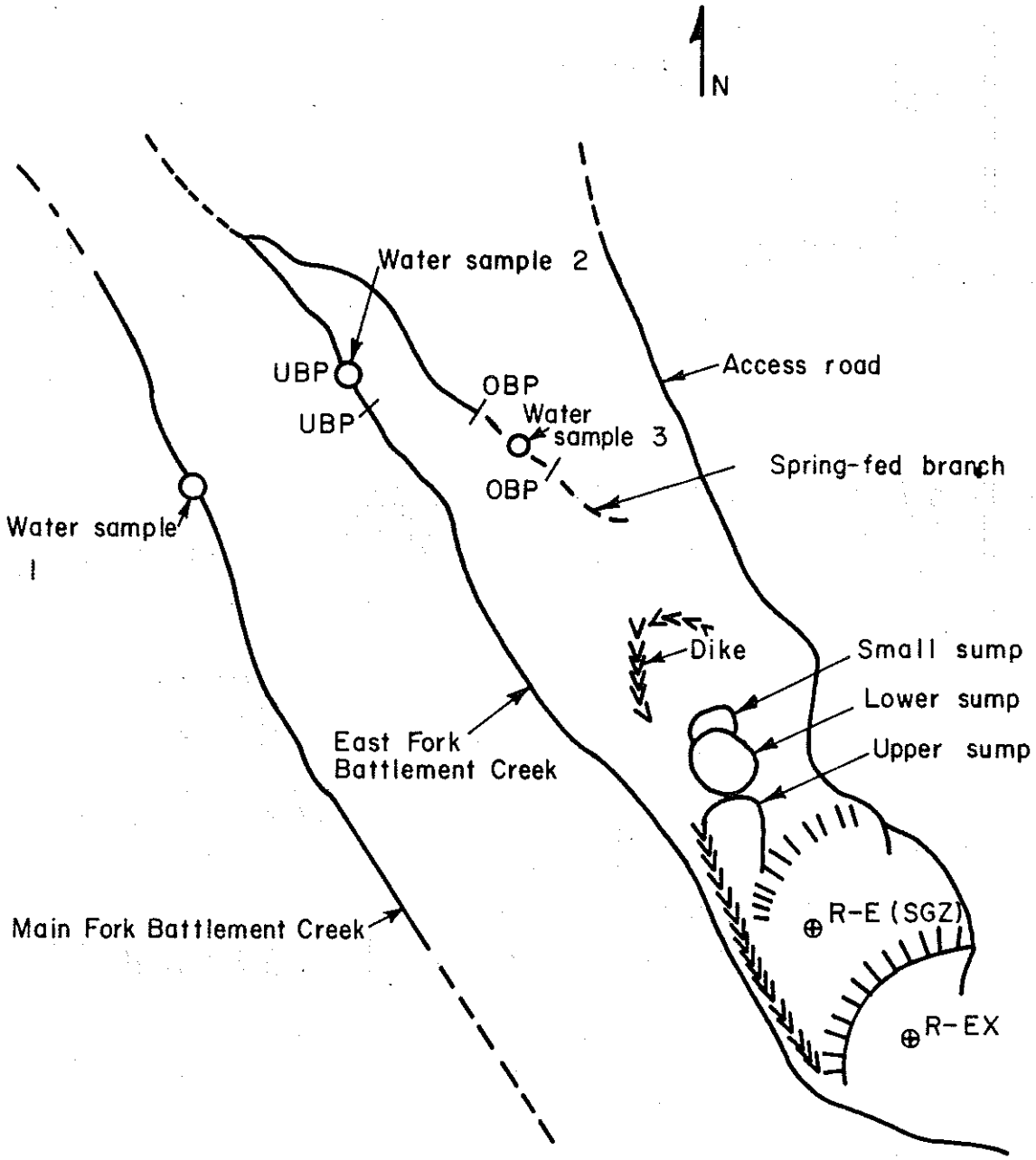


FIGURE 4. SCHEMATIC PLOT OF DITCH SYSTEM DISTRIBUTING BATTLEMENT CREEK WATER

TABLE 1. WATER-RIGHTS ASSIGNMENTS, BATTLEMENT CREEK

Priority No. on Creek	Court Priority No.	Name of Ditch	Date of Priority	Date of Decree	Amount, cfs
1	25	Battlement	6/12/84	5/5/88	1.66
2	28	Huntley	3/1/85	5/5/88	1.66
3	22	Battlement	6/1/85	5/5/88	6.66
4	44	R. F.	11/25/85	5/5/88	2.00
5	60	Hewitt & Milburn	8/9/86	5/5/88	2.56
6	67	R. F.	3/7/87	5/5/88	2.37
	67	Dobey	3/7/87	5/5/88	1.97
	67	R. F.	3/7/87	5/5/88	0.40
7	68	Huntley	3/10/87	5/5/88	4.49
8	71	Musconetcong	3/20/87	5/5/88	2.06
9	80	Shutt	5/11/87	5/5/88	3.00
10	81	Battlement	6/8/87	5/5/88	3.00
11	85	Battlement	7/21/87	5/5/88	3.33
12	100	Shutt	12/1/87	5/5/88	3.00
13	101	R. F.	12/20/87	5/5/88	2.86
14	103	Huntley	1/28/88	5/5/88	1.66
	103	Huntley	1/28/88	5/8/88	1.37
15	108	Musconetcong	3/7/88	5/5/88	1.40
16	108a	Huntley	7/29/88	4/4/98	1.00
	108a	Dobey	7/29/88	4/4/98	1.00
17	110	Battlement	5/21/91	4/8/93	2.00
18	Res. No. 5	Battlement Res. No. 1	7/31/94	7/19/97	92.9 (a)
	Res. No. 6	Battlement Res. No. 2	7/31/94	7/19/97	57.9 (a)
	Res. No. 7	Battlement Res. No. 3	7/31/94	7/19/97	408.67 (a)
	Res. No. 8	Battlement Res. No. 4	7/31/94	7/19/97	77.63 (a)
	Res. No. 9	Battlement Res. No. 5	7/31/94	7/19/97	32.35 (a)
19	116	Dobey	6/29/93	7/11/02	3.00
20	117a	DeWitt	4/8/94	12/17/02	1.50
21	117b-1	O'Toole	6/1/94	8/22/07	3.94
22	117b	Musconetcong	7/1/94	12/17/02	1.20
23	108aaaa	Musconetcong	4/6/88	4/22/11	1.00
24	143bb	R. F.	12/20/09	4/16/10	1.00
25	148	Musconetcong	10/14/14	11/8/15	0.12
26	213	Wayne	4/2/53	7/9/65	3.00

(a) Acre feet.



OBP = Occupied Beaver Pond
UBP = Unoccupied Beaver Pond

FIGURE 5. SKETCH OF RULISON SITE AND WATER-SAMPLING LOCATIONS

TABLE 2. WATER-QUALITY ANALYSIS OF SURFACE WATERS COLLECTED NEAR RULISON SGZ

Samples Collected April 3, 1969

	Sample 1, Main Fork Battlement Creek	Sample 2, East Fork Battlement Creek Below SGZ	Sample 3, Tributary to East Fork Battlement Creek Below SGZ
pH	8.09	7.76	7.94
Total dissolved solids, ppm	102.0	250.0	294.0
Alkalinity, ppm	62.0	168.0	228.0
Bicarbonate, ppm	76.0	205.0	278.0
Carbonate, ppm	0	0	0
Total iron, ppm	0.10	0.44[a]	0.04
Total hardness ($CaCO_3$), ppm	68.0	156.0	216.0
Calcium, ppm	19.2	40.0	56.0
Magnesium, ppm	9.20	25.76	34.96
Sulfate, ppm	24.0	14.4	19.2
Chloride, ppm	7.0	9.0	10.0
Nitrate, ppm	0.30	1.0	0.10
Sodium and potassium, ppm	13.31	18.26	21.21

(a) Exceeds top level of 0.30 ppm recommended by U. S. Public Health Service Drinking Water Standards, Revised 1962 (PHS Publication No. 956).

continuing contribution of inorganic contaminants from the drill site, even though the amount is presently not great enough to constitute a hazard. What is of concern is the possibility that under different runoff conditions, or disturbance of the site by ground motion at shot time, a heavy enough load could enter the stream to adversely affect water quality in Battlement Creek.

Evidence of some oil entrapment in bottom silt in unoccupied beaver ponds below the drill site was also noted during water sampling. A tree trunk extending into the pond bottom was inadvertently shaken and immediately afterward bubbles of oily material came to the surface and spread over the pond water as distinct "oil slicks". Further probing of the pond bottom with a stick produced similar surface slicks.

It is tentatively suggested that there may be some residual oil absorbed on fine mud particles introduced into the stream from the mud-sump failure reported during drilling of Hole R-EX. The particles may have settled to the bottom of the beaver ponds and could conceivably contribute to stream pollution if the beaver dams should be breached by ground shock. To estimate how serious this possible hazard may be would require further sampling and analysis of the pond sediments. This possible source of contamination is presently believed to be less of a real hazard than release of pollutants from in and around the mud sumps, in terms of potential adverse effects on drinking- and irrigation-water quality.

Battlement Creek is not only valuable as a source of water for domestic use, irrigation, and stock watering; it is also a trout stream. Fishing is not heavy, but the stream is fished as are the Battlement reservoirs that feed into Battlement Creek. The Colorado Game, Fish and Parks Department was concerned enough by the report of a pollution incident in December, 1967, to follow it up with three surveys, utilizing "electrofishing" techniques to determine fish populations above and below the suspected source of pollution. The surveys were made on April 22, July 11, and August 7, 1968. The results of these surveys led to the conclusion that pollution from the sump pit killed all of the fish in the creek for a distance of at least 2.3 miles below the point of entrance, which was as far downstream as the survey was carried out. Damage to bottom organisms (aquatic insect larvae) was reported to have been limited to a short section of stream just below the site, and that section appeared to be recovering rapidly. The investigators did not attempt to identify precisely what pollutant was responsible for the reported fish kill, and indeed this would have been difficult because of the long period between the initial report (December 27, 1967) and the first opportunity to check fish populations (April 22, 1968). The attention of the Game, Fish and Parks Department was first called to the incident by a complaint from a Mr. Herwick, who used water from Battlement Creek to fill a domestic cistern. The complaint report referred to the pollutant simply as "drilling mud".

Trout adapted to life in a clear stream can be killed by the sudden introduction of a loading of fine particulate matter of almost any composition. Hydrocarbon pollutants such as diesel fuel can be toxic alone, and would probably enhance the toxicity of any particulate or dissolved chemical pollutant.

Cutthroat trout eggs are present in the Battlement Creek gravel beds from about mid- or late-May until about mid-August. During this period, the eggs could be smothered by introduction of fine particulate matter, whether derived from slides of the native soil or from polluted soil from around the drill site. Some smothering of bottom-dwelling larvae of insects utilized by the trout as feed sources could also occur from similar causes, but such organisms are probably much less sensitive, and effects on the benthic fauna would likely be less adverse than on the fish and fish eggs.

Conclusions. Any significant pollution of Battlement Creek with industrial or domestic wastes from the site, or an unusually heavy loading of particulates from shock-triggered earth slides into the Creek channel, could have the following undesirable consequences.

(1) Battlement Creek water could be contaminated, resulting in hardship and economic loss to the people who depend on the creek water for domestic use, stock watering, and irrigation.

(2) Existing populations of native cutthroat and stocked rainbow trout in Battlement Creek could be destroyed or reduced in size.

(3) Eggs of cutthroat trout in gravel beds could be killed by smothering or by pollution, if pollutants are allowed to enter the stream during the period mid-May through mid-August.

(4) Populations of bottom organisms serving as feed sources for trout could be partially or completely destroyed, although the probability of this is not considered to be high.

Recommendations. The preventive actions recommended on the basis of the present evaluation are as follows:

(1) Take such steps as are required to prevent the pollution of Battlement Creek by oil, drilling muds and wastes, or any other industrial contaminants from the Project Rulison drill site.

(2) Take all necessary precautions to prevent entrance into Battlement Creek of any domestic wastes resulting from site occupancy.

Consideration should be given to conducting the following surveillance efforts, in order to document effects of Project Rulison operations on the quality of Battlement Creek water or on the fish populations of the creek:

(1) Establish a water-sampling and water-quality analysis program on the Battlement Creek watershed. Three sampling locations are suggested for consideration as follows:

(a) East Fork of Battlement Creek, 100 to 200 feet above the drill site, i.e., far enough upstream to be above any source of pollutants attributable to the site.

(b) East Fork of Battlement Creek, 100 to 200 feet above its confluence with the main stream. Samples from this station would reflect any changes in water quality that might be Rulison site-related.

(c) Battlement Creek below the aforementioned confluence and above the exit point of the first distribution ditch. Samples from this location would provide an evaluation of the creek water just above the uppermost use point.

(A standard water-quality analysis such as that reported in Table 2 would probably serve to detect any significant changes in the chemical composition of the water. If the presence of hydrocarbon pollutants in the samples should be suspected on the basis of odor or surface film, special analyses for hydrocarbons might be needed. At least one set of samples should be collected and analyzed during late pre-event time, and a corresponding set at early post-event time. The advisability of collecting and analyzing additional samples should be considered on a need basis, e.g., if there should at any time be reason to suspect that pollutants from the drill site have accidentally entered Battlement Creek.)

(2) Conduct a pre-event and a post-event survey of the fish populations in appropriate sections of the Battlement Creek system. Standard electrofishing techniques may be used for the surveys, which will serve to evaluate the impact the Rulison event might have on fish populations in the creek. Suggested survey locations are:

(a) A section of the East Fork, above the Project Rulison site

(b) A similar section of this branch below the site and above its confluence with the main stream

(c) A section of the main stream below the confluence.

Battlement Reservoirs

The Main Fork of Battlement Creek rises in a group of five spring-fed reservoirs located on Battlement Mesa at an elevation of about 10,150 feet. These impoundments are formed behind earthen dams constructed in the 1890's. They were originally designed for manual regulation and release of water to the creek during periods of low discharge. At present, however, the headgates are sealed and no such regulation is practiced. Water level is reported to remain relatively constant, with input in excess of storage capacity escaping into Battlement Creek through spillways.

The deeper reservoirs are stocked with trout by the Colorado Game, Fish, and Parks Department. Access to these reservoirs is difficult but the Department reports that a number of fishermen do visit them each summer and good catches are reported. Ground motion damage to the earthen dams resulting in a drop in water level could render the affected reservoirs unsuitable for trout and thus adversely affect a recreational resource of some value.

Miscellaneous Ecological Considerations

The Golden Eagle, a cliff-nesting species, is known to nest in suitable sites in the Battlement Mesa area. It is conceivable that in a few cases, nest sites close to SGZ could be destroyed by rock falls, but no long-range adverse effect on the population is considered likely. The Golden Eagle is not considered to be an "endangered" species in the area of interest, and loss of a few nesting sites would not be expected to have any adverse effects on the population.

The Bald Eagle, which is an endangered species, is not known to nest near the Rulison site.

Time Distribution of Ecological Events

The time distribution of the major bioenvironmental events discussed above, in relation to the bioenvironmental safety aspects of Project Rulison, is shown in Figure 6.

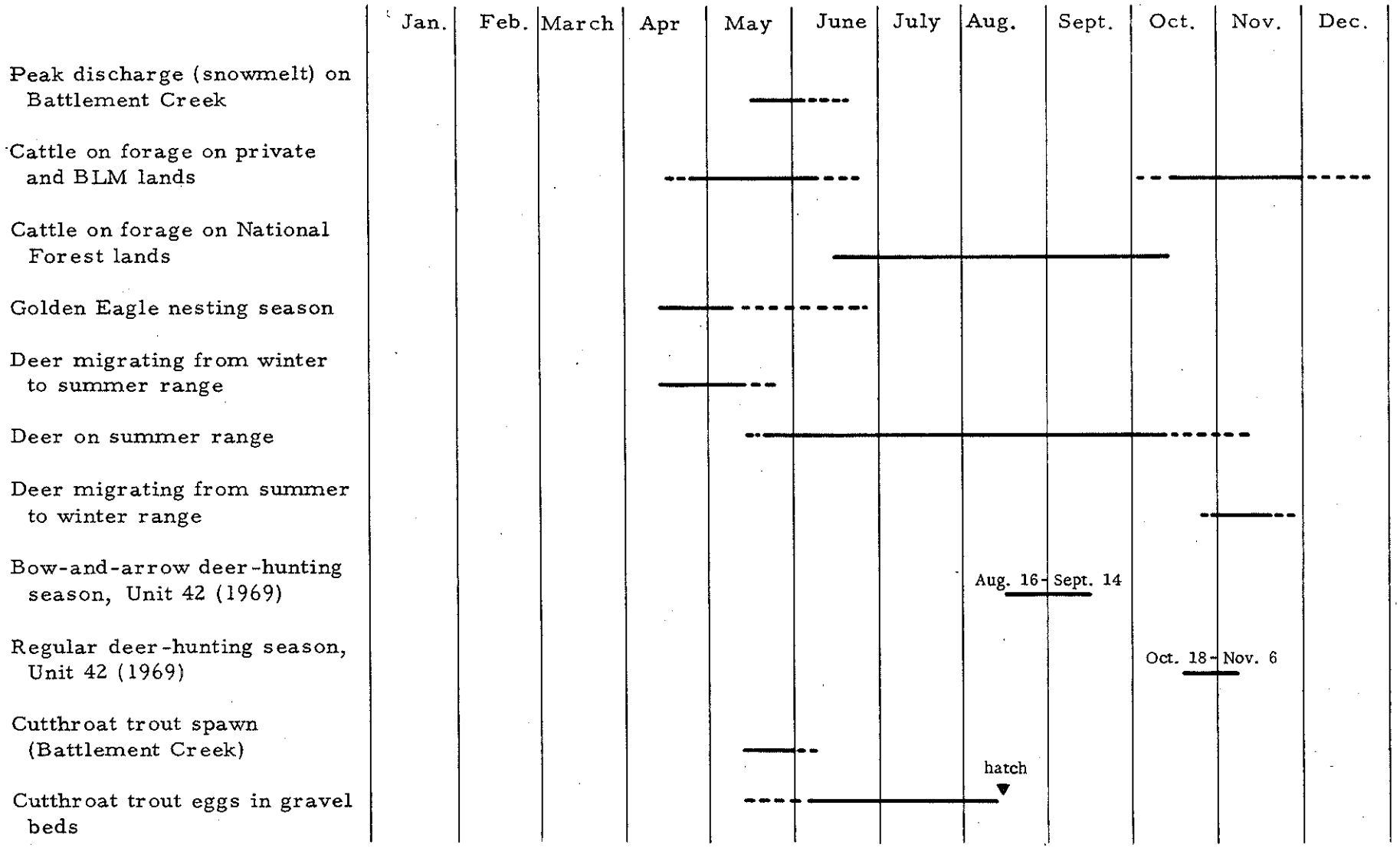


FIGURE 6. TIME DISTRIBUTION OF IMPORTANT BIOENVIRONMENTAL EVENTS, PROJECT RULISON SITE

SOURCES OF INFORMATION

Range Livestock Distribution

Mr. Lawrence Forman, District Ranger
Mr. Joseph Remick, Assistant District Ranger

Rifle Ranger District
White River National Forest
Rifle, Colorado

Mr. Doyne Mayberry, District Ranger

Collbran Ranger District
Grand Mesa National Forest
Collbran, Colorado

Mr. Robert Kline, Range Management Specialist
Mr. Ernest Most, Range Management Specialist

U. S. Department of the Interior
Bureau of Land Management
Grand Junction, Colorado

Wild Game Distribution and Harvest

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Mr. Marion Lowery, Wildlife Conservation Officer
Colorado Game, Fish and Parks Department
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Battlement Creek Watershed

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Battlement Creek Watershed (Cont'd.)

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